RESPIRATORY MEDICINE (1997) **91**, 402–405

Artificial pneumothorax by the Veress cannula: efficacy and safety

P. FAURSCHOU* AND K. VISKUM†

*Department of Pulmonary Medicine, Gentofte University Hospital, Hellerup, Denmark
†Department of Pulmonary Medicine, Bispebjerg University Hospital, Copenhagen, Denmark

In 16 patients with pulmonary fibrosis, an artificial pneumothorax was introduced using the Veress cannula and the Saugman water manometer. Atmospheric air was introduced by fractionated insufflation to a total volume of 800 ml (median). The interpleural space was found on the first attempt, and in all cases, fractionated insufflation of atmospheric air was conducted while the intrapleural pressure was controlled with the water manometer. In one case, the procedure was stopped because of a rise in the pleural pressure after insufflation of only 50 ml air. This was undoubtedly caused by pleural adhesions not visible on chest X-ray. The main concern with air insufflation is air embolism but this was not observed clinically in any of the present cases. The patients in the present study all suffered from pulmonary fibrosis judged by clinical examination, chest X-ray and pulmonary function tests. Despite a diffusion capacity (*D*CO/VA) with a median value of 48% expected, the procedure was well tolerated. It has previously been shown that artificial pneumothorax preceding thoracoscopy is well tolerated due to hyperventilation, with an increase in respiratory frequency and a fall in arterial CO_2 concentration ($PaCO_2$), while pH and arterial O_2 concentration (PO_2) remain constant. This probably also explains the tolerance of the patients in this material. Insufflation of air as described here should be restricted to senior pulmonologists because it is an infrequent procedure. The present authors found the procedure to be uncomplicated and easy to perform with little discomfort to the patients.

RESPIR. MED. (1997) **91**, 402–405

Introduction

Artificial pneumothorax in patients with severe phthisis was first reported by Forlanini 1894 (1). Forlanini used a closed method ('die Punktionsmetode') of administering nitrogen, in contrast to Murphy and Brauer who incised the skin and muscle ('die Snittmetode') and introduced large volumes of gas intrapleurally (2,3). Saugman introduced the water manometer in 1906, making it possible to introduce gas into the pleural space under controlled circumstances (4), and thoracoscopy and cauterization of adhesions were introduced by Jacobeus in 1913 (5). A summary of these historical milestones has been compiled by Sakula (6). The introduction of the Veress cannula in 1984 for introducing artificial pneumothorax in pulmonary diseases has made this procedure easy (7). The aim of the present study was to evaluate the effectiveness and safety of the Veress cannula in introducing a pre-thoracoscopic artificial pneumothorax in 16 patients with presumed pulmonary fibrosis.

Received 18 July 1995 and accepted in revised form 2 September 1996.
Correspondence should be addressed to: P. Faurschou, Department of Pulmonary Medicine Y, Gentofte University Hospital, Niels Andersens Vej 65, DK-2900 Hellerup, Denmark.

Materials and Methods

Sixteen patients with a median age of 50 years (range: 24–70 years), nine males and seven females, with diffuse bilateral reticulonodular changes (by conventional chest X-ray) were examined.

The following procedure was performed by trained senior pulmonologists. After oral pre-medication with 10 mg diazepam and local anaesthesia of the skin and intercostal muscle, a skin incision was made in the mid-axillary region. The Veress cannula (Plate 1), connected to the Saugman water manometer (Plate 2), was introduced through the skin. In all cases, the operator could feel when the parietal pleura

0954-6111/97/070402+04 $12.00/0

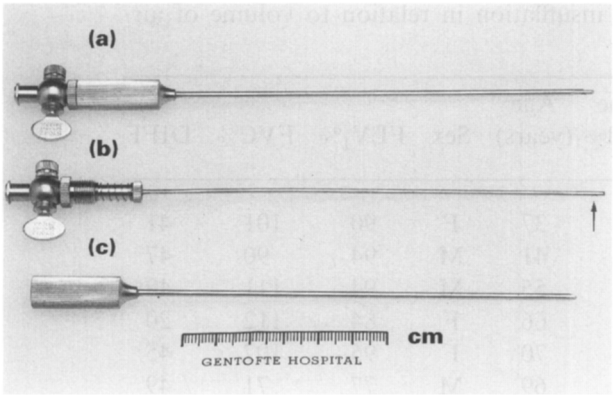

PLATE 1. (a) The Veress cannula in toto with springloaded blunt cannula, (b) the separated blunt inner cannula with side-hole (arrow), and (c) the separated sharp outer cannula.

was perforated, and observe negative respiratory fluctuations on the manometer. Air insufflation was performed fractionated until the pleural pressure neared zero, or 800–1000 ml air had been insufflated. The reason for not allowing air into the pleural space through an open cannula is the advantage gained by knowing the exact amount of air insufflated under continual observation of the pleural pressure. The Veress cannula was withdrawn, and the closed artificial pneumothorax was confirmed by either chest roentgenogram or fluoroscopy. Thoracoscopy was performed with local anaesthesia (8).

In all patients, measurements of lung function were performed including forced expiratory volume in 1 s (FEV_1), forced vital capacity (FVC), residual volume (RV), total lung capacity (TLC) and diffusion capacity (*D*CO/VA: ml min^{-1} $mmHg^{-1}$ l^{-1}).

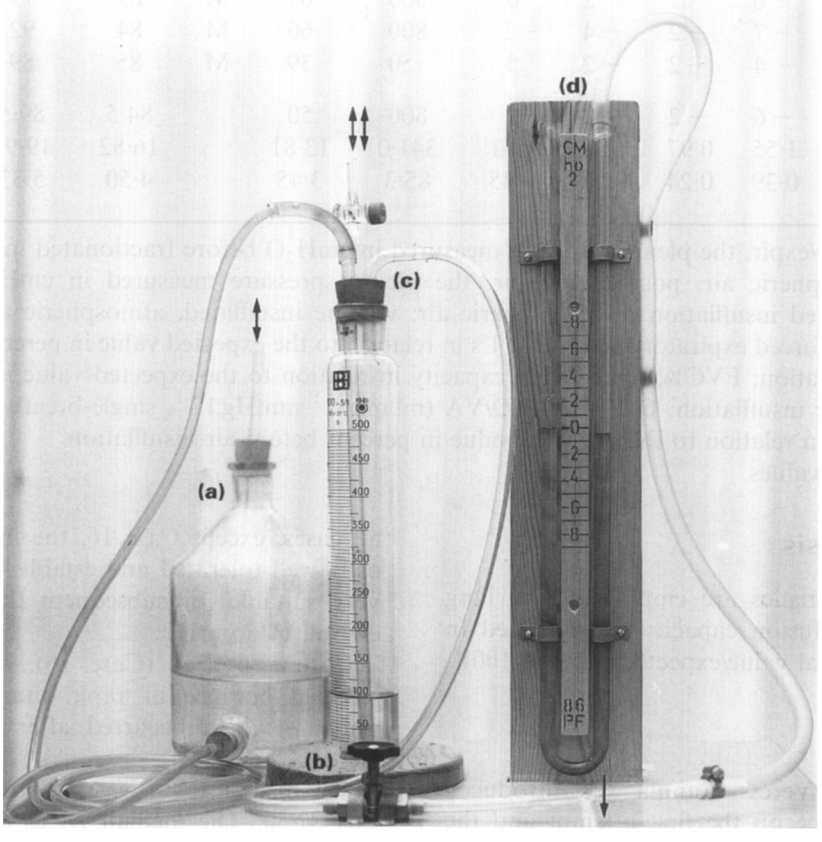

PLATE 2. The water manometer is a modification of Saugman's original model. (a) Bottle with sterile water open to the atmosphere (double arrow). Elevation of the bottle forces the water into the vial (c) by gravity. (b) Stopcock separating the insufflation instruments from the water manometer and the patient. (d) The water manometer. The arrow shows the connection to the Veress cannula and to the patient. When negative respiratory fluctuations are observed, the stopcock (b) is opened and fractionated air could be insufflated under continuous observation of the pleural pressure. For later equalization with the atmosphere, the vial (c)'s stopcock (marked with double double arrow), can be opened after stopcock (b) has been closed.

TABLE 1. Pleural pressure before and after air insufflation in relation to volume of air insufflated and the pulmonary function (n=16)

Patient number	Pre-inspir	Pre-expir	Post-inspir	Post-expir	Volume insuffl	Age (years)	Sex	FEV_1%	FVC%	DIFF
1	−6	−2	−2	0	1000	37	F	90	101	41
2	−4	−2	−2	0	700	41	M	94	90	47
3	−5	−3	−2	−1	800	55	M	94	111	49
4	−4	−2	−2	0	900	66	F	84	112	20
5	−7	−4	*	*	800	70	F	95	107	45
6	−4	−2	−1	0	1500	69	M	77	71	49
7	−3	−2	−1	0	1000	59	M	45	47	65
8	−6	−2	−4	−1	600	45	F	*	*	*
9	−9	−5	*	*	700	44	F	83	92	28
10	−6	−4	−1	0	1000	24	F	57	58	66
11	−6	−2	*	*	1500	44	M	50	63	67
12	−4	−2	−1	0	750	59	F	92	88	39
13	−6	−2	−2	0	600	41	M	*	*	*
14	−6	−2	−2	0	800	69	M	69	79	67
15	−7	−2	−4	−2	800	60	M	84	92	41
16	−4	−2	−2	5	50	39	M	85	89	50
Median	−6	−2	−2	0	800	50		84·5	89·5	48
SD	1·55	0·97	1·00	1·61	341·0	13·81		16·82	19·95	14·45
SE Mean	0·39	0·24	0·28	0·45	85·3	3·45		4·50	5·33	3·86

Pre-inspir/expir, the pleural pressure measured in cmH_2O before fractionated insufflation of atmospheric air; post-inspir/expir, the pleural pressure measured in cmH_2O after fractionated insufflation of atmospheric air; volume insufflated, atmospheric air in ml; FEV_1%, forced expiratory volume in 1 s in relation to the expected value in percent before air insufflation; FVC%, forced vital capacity in relation to the expected value in percent before air insufflation; DIFF, DACO/VA (ml min^{-1} mmHg l^{-1}, single-breath diffusion capacity in relation to the expected value in percent before air insufflation.
*missing values.

Statistical Analysis

Only descriptive statistics are employed. The lung volume and the diffusion capacity are reported in relative values [(actual value/expected value) × 100)].

Results

In all 16 cases, the Veress cannula was introduced into the pleural space on the first attempt and the artificial pneumothorax was established without complications.

The pre-inspiratory/pre-expiratory pleural pressure was $-6/-2\ cmH_2O$ (median), and the post-inspiratory/post-expiratory pressure was $-2/0\ cmH_2O$ (median).

The total volume of atmospheric air insufflated was 800 ml (median) (range: 600–1500 ml), and in all cases, except Case 16, the insufflation was clinically well tolerated and established a pneumothorax very suitable for subsequent thoracoscopy. No air embolism occurred.

In one patient (Case 16), the insufflation was stopped because of rapid increase in the pleural pressure which occurred after insufflation of only 50 ml air.

The median RV% was 102, and the median TLC% was 82·50. The median DCO/VA was 49% of predicted normal value. The demographic data is shown in Table 1.

Discussion

In a previous report (7), 19 patients had experienced induced pneumothorax with Veress cannula and

Saugman's water manometer with ease and without any complications.

Before this era, the original Saugman cannula was used (9). This is more difficult to position and maintain in the pleural cavity. The cannula model by Kjer-Petersen (10) with a side-gap in the inner cannula was close to the idea of the Veress cannula, but Saugman's and Kjer-Petersen's cannulae were sharp whilst the Veress inner-cannula is blunt with a side opening permitting registration of the pleural pressure and fractionated air insufflation (Plate 1).

In this study of 16 patients with suspected pulmonary fibrosis, the pleural cavity was found on the first attempt and fractionated insufflation of atmospheric air under control of the water manometer was achieved (4,7). In one patient, the procedure was stopped because of a rise in pleural pressure after insufflation of only 50 ml air. This was undoubtedly caused by pleural adhesions not visible on chest X-ray. The main concern with air insufflation is air embolism but this was not observed clinically in any of the patients. The pressure with which air was insufflated never exceeded 10 cmH_2O, and inflation was stopped if the patient experienced discomfort or resistance to insufflation was experienced. In this way, air embolism, tearing of adhesions or cardiac disturbances were avoided. Different gases, usually nitrogen, have been introduced into the pleural cavity (1–4) because nitrogen is absorbed more slowly from the cavity than, for example, oxygen or atmospheric air (11). This was significant in the collapse treatment of the tubercular lung, but as a pre-thorascopic preparation, insufflation of atmospheric air seems to be a practical and simple solution. In some studies (12), CO_2 insufflation has been used, but this is without proven advantage.

The patients in this study presumably suffered from pulmonary fibrosis. Despite a diffusion capacity with a median value of 48% expected, the procedure was well tolerated. It has previously been shown (13) that artificial pneumothorax preceding thoracoscopy is well tolerated on account of hyperventilation, with an increase in respiratory frequency, a fall in $PaCO_2$ and pH and PO_2 remaining constant. This is probably also the reason for the good tolerance in this study. Air insufflation as described here should be performed by a senior physician with practical experience, as well as a good knowledge of respiratory physiology. Under these circumstances, the procedure is easy, safe and uncomplicated with little discomfort to the patients.

References

1. Forlanini C. Primo tentativi di pneumothorace artificiale della tisi pulmonare. *Gazzetta Medica di Torino* 1894; **45:** 381–384, 401–403.
2. Murphy JB. Surgery of the lung. *JAMA* 1898; **31:** 151–165, 208–216, 281–297, 341–356.
3. Brauer L. Die behandlung der enseltigen Lungenphthisis mit künstlichen Pneumothorax (nach Murphy). *Munch Med Wochenschr* 1906; **53:** 338–339.
4. Saugman C. Ûber die Anwendung des künstlichen Pneumothorax in der behandlung der Lungentuberkulose. *Zeitschrift für tuberkulose* 1908; **12:** 1.
5. Jacobaeus HC. Ûber laparo-und thorakoskopie. *Beitr Klin Tuberk* 1913; **25:** 1–170.
6. Sakula A. Carlo Forlanini, inventor of artificial pneumothrax for treatment of pulmonary tuberculosis. *Thorax* 1983; **38:** 326–332.
7. Faurschou P. Induction of pneumothorax by mean of the Veress cannula. *Eur J Respir Dis* 1984; **65:** 547–549.
8. Enk B, Viskum K. Diagnostic thoracoscopy. *Eur J Respir Dis* 1981; **62:** 344–351.
9. Faurschou P. Diagnostic thoracoscopy in pleuropulmonary infiltrates without pleural effusion. *Endoscopy* 1985; **17:** 21–25.
10. Würtzen CH, Kjer-Petersen R. Om kunstig pneumothorax. *Hospitalstidende* 1908; **18:** 489–494.
11. Saugman C. Om behandlingen af lungetuberkulose med kunstig pneumothoraxdannelse. *Ugeskrift for Laeger* 1907; **39:** 939–941.
12. Brandt H-J, Loddenkemper R, Mai J. *Atlas of Diagnostic Thoracoscopy*. Georg Thieme Verlag, Stuttgart, New York, 1985, pp. 19–20.
13. Faurschou P, Madsen F, Viskum K. Thoracoscopy: influence of the procedure on some respiratory and cardiac values. *Thorax* 1983; **38:** 341–343.